SURGICAL OUTCOME OF UNSTABLE ACETABULAR FRACTURES - A PROSPECTIVE STUDY

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CERTIFICATE

*This is to certify that this dissertation entitled "***SURGICAL OUTCOME OF UNSTABLE ACETABULAR FRACTURES – A PROSPECTIVE STUDY***" is the bonafide work done by* **Dr.P.ARUN ANAND**, *under my direct guidance and supervision in the Department of Orthopaedic Surgery, Madurai Medical College, Madurai-20*

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DECLARATION

I **Dr.P.ARUN ANAND**, solemnly declare that the dissertation titled "**SURGICAL OUTCOME OF UNSTABLE ACETABULAR FRACTURES – A PROSPECTIVE STUDY"** has been prepared by me. This is submitted to **"The Tamilnadu Dr. M.G.R. Medical University, Chennai,** in partial fulfilment of the regulations for the award of M S degree branch II orthopaedics

Place: Madurai

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CONTENTS

ABSTARCT

We reviewed the radiological and functional outcome of open reduction and internal fixation of 18 unstable acetabular fractures in our institution from July 2009 to November 2011. Pre operative evaluation was done with Letournel and Judet views, Axial CT scan and 3D reconstruction scans. The factors affecting the radiological and functional outcome of surgically treated patients were analyzed. The anatomical reduction is found to be the most important and consistent factor affection the outcome. The relationship between the factors such as age, initial displacement, associated injuries, and the time interval between injury and surgery were also evaluated. The radiological outcome was assessed using Matta's criteria while the functional outcome was assessed using Merle d' Aubigṅe and Postel modified score. The post operative fracture reduction as measured on the three plain radiographs were graded as anatomical in 7(39%), imperfect in 6(34%) and poor in 5(28%) cases. The functional outcome which was evaluated with Merle d' Aubigne' and Postel modified score was found to be excellent in 4 patients, good in 6 patients, fair in 4 patients and poor in 4 patients. . The radiological outcome was strongly associated with the functional outcome (p-0.0044) which strongly supports the point that achieving anatomical reduction is the most important aspect. The findings in our study suggest that the achievement of anatomical reduction is the most important factor affecting the outcome. None of our patients

had iatrogenic nerve injury. We encountered complications such as infection (3 out of 18), posterior dislocation of hip (1 out of 18) and plate breakage (1 out of 18).

To conclude, it involves a long learning curve and the treatment should be done in a specialized tertiary care centre which has a specialized team for managing the acetabular fractures. The goal of the surgical treatment should be to produce a functional mobile painless joint that continues to function till the rest of life for the patient.

KEYWORDS:

Acetabular fractures, anatomical reduction, Letournel and Judet views, Kocher Langenbeck, posterior wall.

INTRODUCTION

The incidence of acetabular fractures is on the rise with the increase in the high velocity road traffic accidents. These fractures were treated conservatively during the early days. The literature of 1950s and 1960s discussed inconclusive recommendations for the optimal treatment for the acetabular fractures[1, 2] .The confusions in the management were primarily due to the fact that there was no common fracture classification [3] . Every surgeon had his own method of describing the fracture. But all these authors had agreed that poor results would occur if the injury resulted in either unstable or incongruent joint [1, 2, 3, 4, 5]

It was only after the extensive works by Judet, Judet and Letournel acetabular fractures were seen with clarity. Their publication gave a clear understanding about the basic surgical anatomy, defining the injury via appropriate radiographic assessment and determining a suitable treatment plan[6]. They recommended operative treatment for fractures that involved the weight bearing dome of the acetabulum as the results from conservative treatment were disappointing [6].

The subsequent studies by Letournel and Judet and Matta[7] emphasized anatomical reduction(less than 2mm of displacement) of fracture fragments

was necessary to attain best results with hip congruity and stability. Residual displacement of more the 1mm or 2 mm may lead to poor functional result and early post- traumatic arthrosis[7].

The time interval between injury and the surgery is also critical as the "delayed management of acetabular fractures increases the difficulty of operative treatment and may result in a significant reduction in good to excellent results" [8]. However the acetabular surgery need not be done as an emergency procedure unless there is an irreducible hip dislocation, progressing neurologic deficit, open fractures, or vascular injuries[9].

The surgery for acetabular fractures is complex and technically demanding and there are chances for serious complications even in the hands of experienced surgeons. It involves a long learning curve and most of the poor outcomes are due to poor surgical techniques. This is very well documented in the early works of Matta who himself had unsatisfactory reduction in his early days[10]. Hence the surgery for acetabulum should be performed by experienced surgeons who routinely treat these patients[11, 12, 13].

The initial displacement of the fracture is an important determinant in the outcome after surgical treatment[7]. The surgeon should be well aware of the factors that affect the prognosis of the treatment. The surgical treatment of complex acetabular fractures can be carried out through a single non extensile

approach to reduce the morbidity associated with the extensile exposure[14, 15, 16].

The goal of the surgical management of acetabular fractures is pain free motion and stability to permit vocational and day to day activities without the propensity for future degenerative changes.

AIM OF THE STUDY

To assess the radiological and functional outcome of unstable acetabular fractures treated by open reduction and internal fixation.

REVIEW OF LITERATURE

ANATOMIC CONSIDERATION:

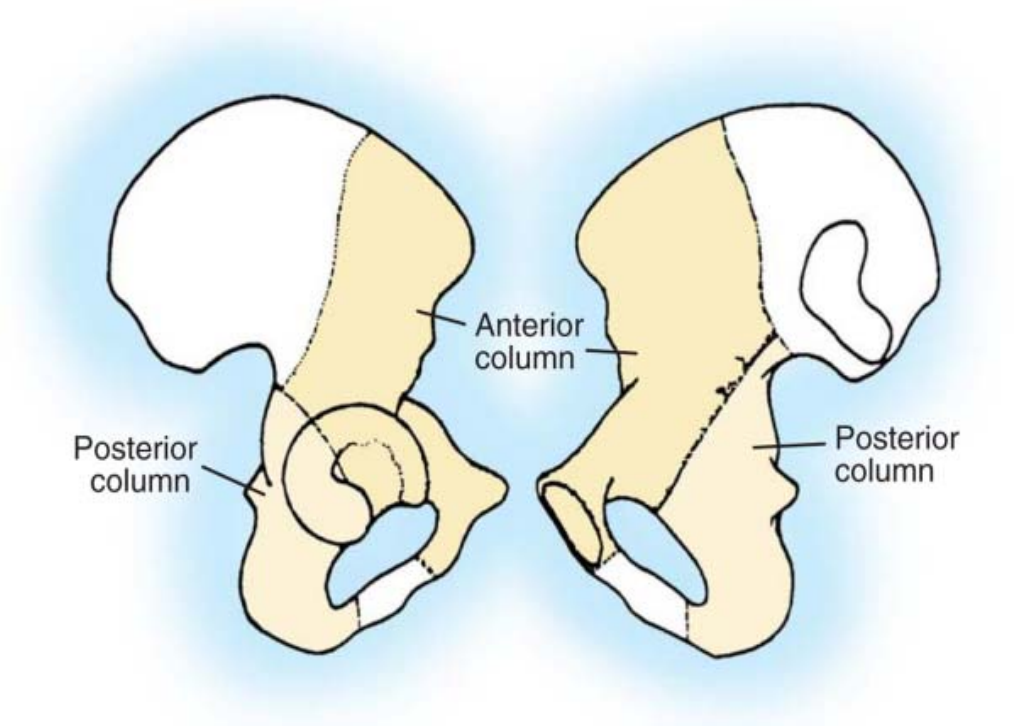
It becomes necessary to review the anatomy of the acetabulum if we are to understand the pathological changes. The surgeon's concept of the acetabulum must not be limited to the socket but should take into consideration the osseous masses that limit and support acetabulum.

Acetabulum is located in the concavity of an arcjh formed by 2 columns of bone, one anterior and the other posterior. These columns converge in a thick and compact zone of bone which is always spared by fracture of acetabulum.

The posterior/ ilioischial column which is voluminous and thick descends caudad as far as the ischial tuberosity. This column is composed of the vertical portion of the ischium and of that portion of the ilium immediately above the ischium. On the anterolateral surface of the column lays the posterior part of the articular surface of the acetabulum, the posterior acetabular rim. On the medial surface of this column is Quadrilateral surface.

The anterior/iliopubic column runs obliquely downward, inward and anteriorly making an angle of 60◦ with the posterior column. Anterior column consist of a short segment of the ilium and of the pubis and extends up as far

as the anterior superior iliac spine of the Ilium. On the posterolateral surface of this column is the anterior portion of the articular surface of the acetabulum, the anterior acetabular rim. These 2 columns form an arch in which the superior angle / keystone is formed by a rounded plate of compact iliac bone, the roof of the acetabulum[17].



Mechanism of Injury:

Fractures of the acetabulam occur by impact of the femoral head with the acetabular articular surface. The pattern of the acetabular fractures depends on the position of the hip at the time of impact as well as the location and direction of originally applied force.

ASSOCIATED INJURIES[7]:

35% with injury involving an extremity

19% with a head injury

18% with a chest injury

13% with a nerve palsy (Sciatic Nerve)

8% with an abdominal injury

6% with a genitourinary injury

4% with an injury of the spine

IMAGING:

X-Ray:

- AP view of the pelvis
- Obturator (45◦ internal Judet) oblique view
- Iliac (45◦ external Judet) oblique view

CT scan: Axial – 3mm cut

3D CT reconstruction scan

Landmarks:

AP view[17]:

1. Superior channel, the arcuate [Iliopectineal line] – Anterior column

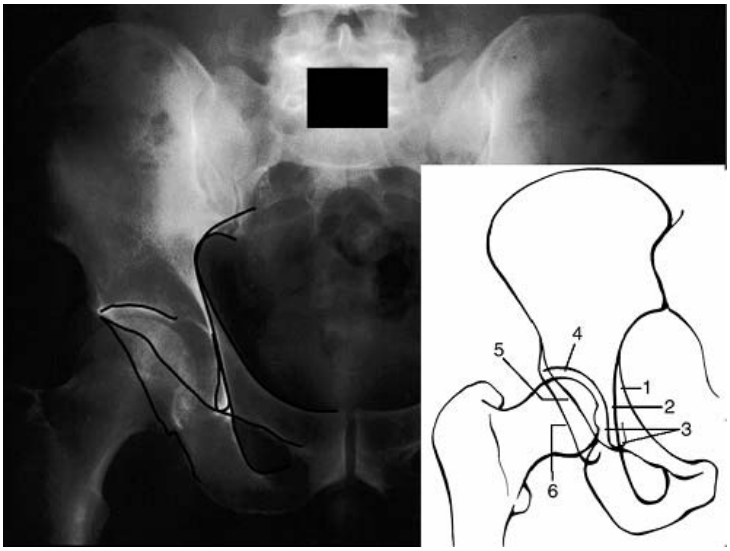
2. Ilioischial line – Posterior column

3. Roengenographic 'U' / Teardrop

4. Roof of the acetabulum

5. Anterior lip

6. Posterior lip



CT Scan Axial:

1. Extent and location of acetabular wall fractures

2. Presence of intra articular free fragments / injury to femoral head

3. Orientation of fractures lines

4. Identification of additional fracture lines

5. Rotation of the fracture fragments

6. Status of posterior pelvic ring

7. Marginal impaction (defined as the depression of articular surface of joint)

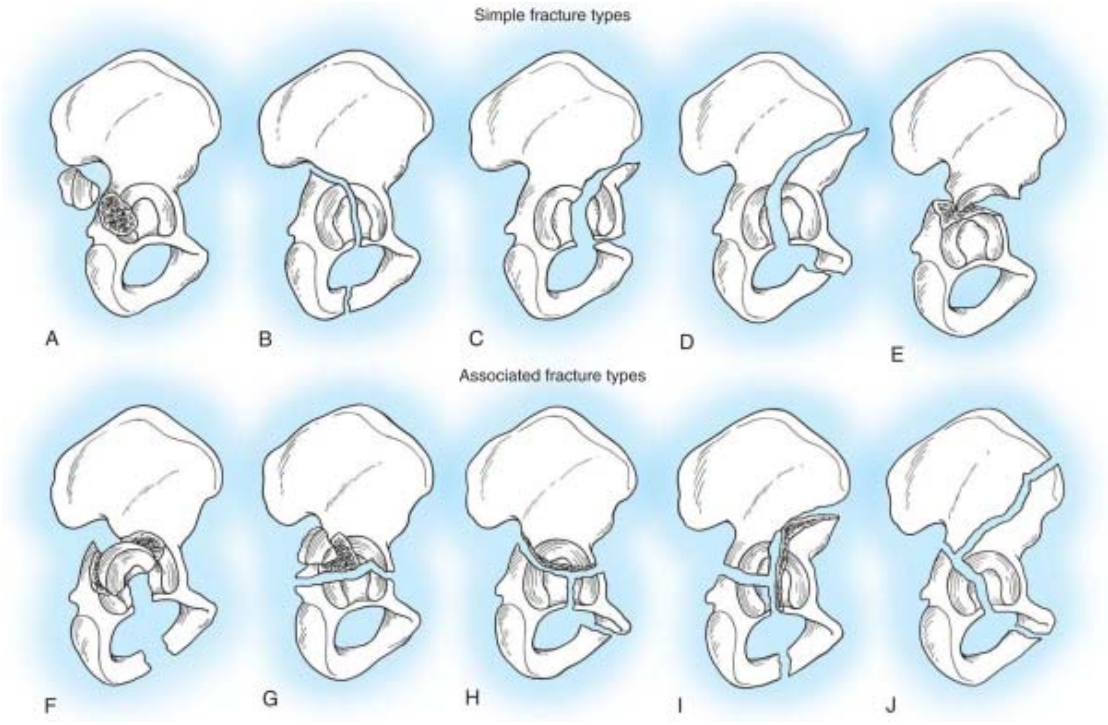
3D – CT Reconstruction:

- Useful to assess the amount of displacement and the anatomical extent of the fracture.

ANATOMICAL CLASSIFICATION:

Letournel and Judet Classification[17]:

Elementary	Associated fracture patterns
Posterior wall	Posterior column and posterior wall
Posterior column	Transverse and post wall
Anterior wall	Anterior column / wall and post. hemitranverse
Anterior column	T shaped
Transverse	Both column



AO classification:

Type A: Fracture involves only one of two columns of acetabulum

- A1: Posterior wall fracture and variations
- A2: Posterior Column fracture and variations
- A3: Anterior Wall and Anterior column fracture

Type B: Transverse fractures, position of roof remains attached to intact ilium

- B1: Transverse fracture and Transverse + Posterior wall fracture
- B2: T shaped fracture and variations
- B3: Anterior Wall /column + Posterior Hemitranverse fracture

Type C: Fracture of anterior & posterior columns. No portion of roof remains attached to intact ilium.

- C1: Anterior Column fracture extending to iliac crest.
- C2: Anterior Column fracture extending to anterior border of ilium
- C3: Fracture enters SI joint

RATIONALE OF TREATMENT:

Goal:

Pain free motion & stability to permit vocational & day to day activities without the propensity for future degenerative changes.

Intra-articular congruity:

Intraarticular congruity (<2mm) remains the most clinically significant radiological parameter regarding the functional outcome & degenerative changes.

MANAGEMENT:

Acetabular fractures may be treated by conservative and operative methods.

CONSERVATIVE MANAGEMENT:

Indications:

- Non displaced and minimally displaced fractures (< 2mm) displacement in weight bearing done)
- Roof arc angle > 45◦ in all three views [18].
- No fracture involvement in cranial 10mm of joint in CT (CT subchondral arc).
- No femoral head subluxation on 3 X-rays taken out of traction.
- For posterior wall fractures - <40% of width of wall on CT.
- Secondary congruence in displaced both column fractures.
- Highly comminuted fractures.

Treatment:

The patient is put on skeletal traction for 6 weeks. Partial weight bearing is allowed in 8 weeks. Full weight bearing is allowed only after 3 months. Serial radiogarphs are taken to monitor the fracture union, displacement, and development of arthrosis or osteonecrosis.

OPERATIVE TREATMENT:

Indications:

- Fractures involving >50% of articular surface
- Displacement of >2mm in weight bearing dome
- Roof arc angle[15] – Medial roof arc <45◦

  Anterior roof arc <50◦

  Posterior roof arc < 60 ◦

Timing of surgery:

The surgery should be performed ideally in 5-7 days. The surgery must be performed within 3 wks to achieve a better result. Anatomical reduction becomes more difficult after that time because hematoma organization, soft tissue contracture, and subsequent early callus formation hinder the process of fracture reduction, especially if more limited Kocher Langenbeck or Ilio inguinal exposure is used[19].

Choice of surgical approach:

The choice of surgical approach is determined by the fracture pattern, the elapsed time from injury, the magnitude and location of maximal fracture displacement. A single surgical approach is generally selected with the expectation that the fracture reduction and fixation can be completely performed through the one approach [14,15,20,21.] Also, as extensile/ two approaches result in higher morbidity like skin necrosis, infections and myositis ossificans, single approach is preferred[14,15].

The general choice of surgical approach is as follows[22]:

Elementary Fractures:

- Posterior wall → Kocher Langenbeck
- Posterior Column → Kocher Langenbeck
- Anterior wall / Column → Ilioinguinal
- Transverse infratectal/ Juxtatectal → Kocher Langenbeck / Ilioinguinal
- Tranverse transtectal → Iliofemoral/ Kocher Langenbeck

Associated Fractures:

- Posterior Column + Posterior Wall → Kocher Langenbeck
- Anterior +Posterior hemitranverse → Ilioinguinal

- Transverse Infratectal/ Juxtatectal + Posterior wall → Kocher Langenbeck
- Transverse Transtectal + Posterior wall → Iliofemoral / Kocher Langenbeck
- T shaped infratectal/Juxtatectal → Kocher Langenbeck / Combined
- T shaped transtectal → Iliofemoral / Combined
- Both column -→ Ilioinguinal / Iliofemoral / Combined

Principles of surgical treatment:

If the column is more damaged, direct open reduction and plate osteosynthesis is achieved. If the column is less damaged indirect reduction with interfragmentary screws under c-arm guidance should be considered[23].

Peri operative care:

- Antibiotic prophylaxis: I generation cephalosporins preoperatively and at least 24 hours post-OP
- No regular prophylaxis for DVT
- Indomethacin 25mg thrice daily beginning within 24 hrs of surgery and continued for 4-6 weeks[24].

COMPLICATIONS:

Infection:

The rate of infection is approximately 0-3% in most series [7]. Risk of infection is increased in patients with open fractures and local soft tissue injuries such as Morel-Lavelle lesions. If the infection is early, then hardware preservation is attempted to maintain the stability of hip until union; then it is removed. Late infection is treated with hardware removal. In all cases, long term culture, specific antibiotics, usually an empirical course of 6 weeks is used[22].

Iatrogenic nerve injury:

Iatrogenic nerve injury to sciatic nerve is one of the major complications encountered in acetabular fracture management. These injuries are most commonly associated with posterior and extended approaches that involve direct exposure and retraction of the sciatic nerve[25]. There is no substitute for attention to detail in operative rooms with careful patient positioning, maintaining the knee flexed during posterior approaches to sciatic nerve, cautious placement of retractors and limited traction on the nerve during traction[22].

Intra-articular placement of screws:

Letournal and Judet originally proposed taking the hip through range of motion in complete silence in operating room to listen for crepitus as a method of detecting intra articular hardware[20]. Some authors suggested the use of sterile esophageal stethoscope for monitoring intra articular placement of hardware[26]. Others recommended careful intra-operative and postoperative radiography to ensure hardware has been placed outside the joint[27]. If hardware has been placed within the joint, it is imperative that the offending implants be removed. Otherwise post operative arthrosis will almost certainly ensue.

Venous thromboembolism:

Post traumatic and post operative thromboembolim is a significant problem in acetabular fracture patients. The prophylaxis for DVT is not routinely used. High risk patients are treated with subcutaneous Heparin/ Enoxaparin while awaiting surgery. Postoperative anticoagulants with Enoxaparin followed by warfarin are continued for 6-12 wks unless it is medically contraindicated[22].

Heterotopic ossification:

Heterotopic ossification has been reported as occurring in as many as 90% of patients after acetabular fracture surgery (18%-90%) with severe

involvement as high as 50% in some patient groups[28]. Most studies use Brooker's classification which relies solely on the AP radiographic view of the Hip[29]. Most notable risk factor for HO is stripping of gluteal muscles from the external surface of the ilium. Matta[7] reported the following prevalence as Kocher Langenbeck – 8%, extended iliofemoral 20%, Ilioinguinal 2%. Rate of heterotopic ossification can be reduced with use of Indomethacin and radiation therapy[24, 28]. Indometacin 25mg TDS for 6 weeks/ Radiation therapy with 800 cGy delivered within 3 days of surgery can be used to prevent the formation of heterotopic ossification[30, 31].

Post-Traumatic Arthrosis & Osteonecrosis of Femoral head:

The quality of reduction appears to be the main determinant for clinical outcome and for the risk of late traumatic arthrosis[7, 20]. Fracture reduction to within 1mm of residual displacement have better long term outcome and lower prevalence of arthritis. THR or arthrodesis is indicated for patients with post traumatic arthrosis and disabling pain.

MATERIALS & METHODS:

In our institution we have selected cases of unstable acetabular fractures. It is a prospective study done from July 2009 to November 2011.

The age group varied between 18-60yrs among them 13 males and 5 females, right side was involved in 10 cases and left side in 8 patients

Mean follow up was done for 8 months. All fractures have been classified by Letournel and Judet classification [6,20].

All the cases were followed up and were analysed for radiological and functional outcome. The radiological outcome was evaluated with X–ray pelvis AP view, Obturator oblique view and Iliac oblique views[7]. The functional outcome was evaluated with Merle d'Aubigně and Postel modified clinical grading system[32].

MODE OF INJURY:

Road traffic Accidents: 17

Accidental fall from height: 1

ASSOCIATED INJURIES:

Out of 18 cases 8 cases have associated injuries. Pelvic ring fractures were present in 4 patients. Extremity fractures were present in 4 patients. Bladder injury was present in one patient.

Most of the pelvic ring fractures were managed conservatively. Extremity fractures were managed open reduction and internal fixation mostly as staged procedures. One case of bladder rupture was managed with bladder repair and suprapubic cystostomy.

EXCLUSION CRITERIA:

- Age - < 18 yrs and > 60 yrs
- Non displaced & minimally displaced fractures (<2mm displacement in the weight bearing dome)
- Roof Arc angle >45◦ (average of roof arc angle in all 3 views)
- No femoral head subluxation on 3 views taken out of traction
- Secondary congruence in displaced both column fractures

PRE-OPERATIVE PLANNING:

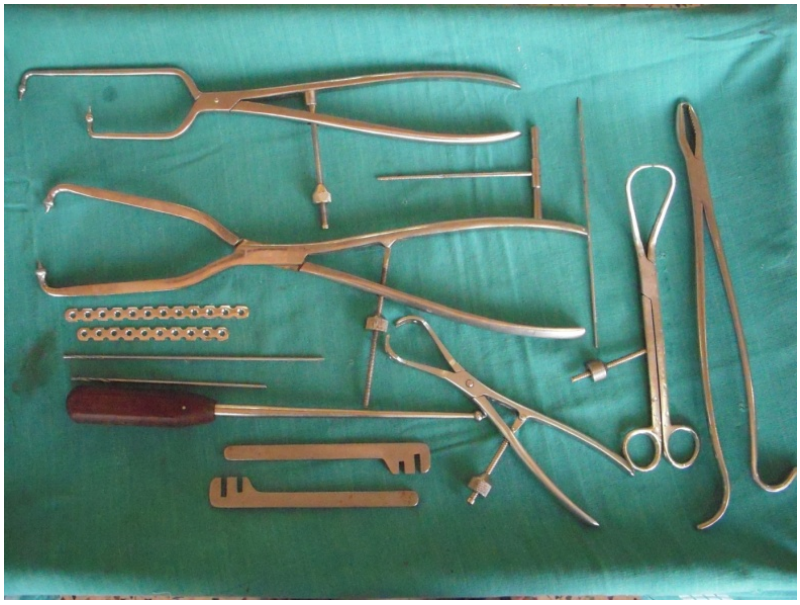
X-ray Pelvis with both hips AP view, Obturator oblique view and Iliac Oblique view, Axial CT and 3D reconstruction CT were taken in all the patients.

TIME INTERVAL BETWEEN INJURY AND SURGERY:

Total of four patients were operated between 3 to 7 days. Nine patients were operated between 7-14 days. Five patients were operated between 14-21 days The mean time interval between injury and surgery was 10. 8 days.

IMPLANTS AND INSTRUMENTS:

- 3.5 reconstruction plates
- 3.5mm cortical screws of various sizes
- 2.7mm long drill bit
- 3.5 mm screw driver
- 1.6mm k-wires
- King tong reduction forceps
- Pointed reduction clamps
- Ball tipped reduction spike
- 4mm Schanz Pin



ANAESTHESIA:

Spinal anaesthesia was used in all the patients

POSITION:

Three positions were used for surgery. Twelve patients were operated in lateral position. Three patients were operated in prone position and three patients in floppy lateral position.

PRONE POSTION

FLOPPY LATERAL POSITION

LATERAL POSITION

SURGICAL APPROACH:

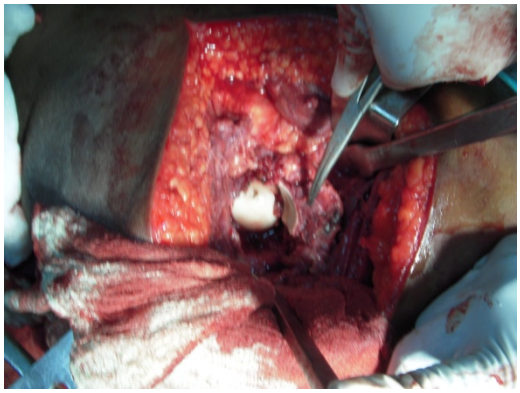
Kocher Langenbeck approach was used in fifteen patients. Iliofemoral approach was used in three patients. The direction of surgical approach was

determined by the amount of displacement of each column and the degree of superior articular surface involvement at each limb of the fracture.

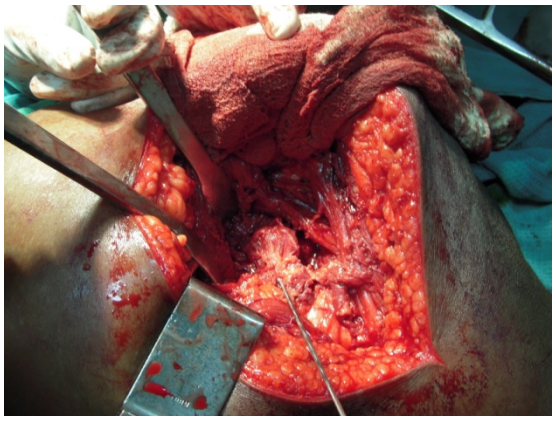
SURGICAL TECHNIQUE:

After exposing the fracture site, the fracture configuration was verified with C-arm. The fracture fragments were reduced using special clamps and Ball tipped spikes. K-wires (1.6mm) were passed to maintain the reduction. Lag screw fixation with 3.5mm cortical screws was done. Buttress plating was done using contoured 3.5mm reconstruction plate or semi tubular plate.. If lag screw fixation was not possible, fracture was reduced and fixed with contoured 3.5mm Reconstruction plate or semi tubular plate.

Kocher Langenbeck approach

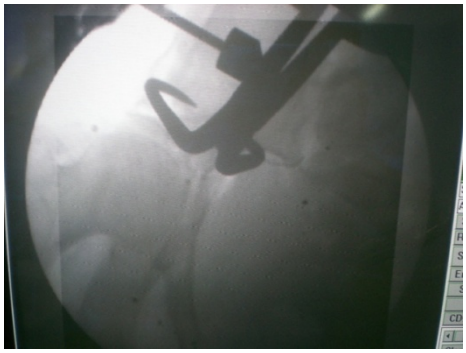


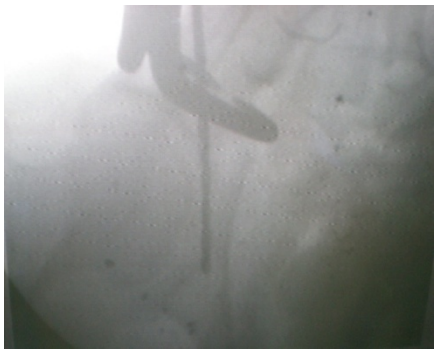
Posterior wall fragment exposed



Provisional Reduction with Fixation with K-wire

IMAGE INTENSIFIER:
All but three cases were operated with the help of Image intensifier (due to technical snag).





C Arm Picture Showing Per Operative Reduction of Fragments

C Arm Picture Showing Per Operative Reduction and Plate fixation

POSTOPERATIVE FOLLOW UP:

Prophylactic intravenous antibiotics were used in all cases for 7 days. Closed suction drain was used in all cases. Suction drain was removed on Day 2 and EOT was done on Day 2.

Suture removal was done on 12th POD. Deep venous thrombosis prophylaxis was not used as a routine in our study. Indomethacin 25mg TDS from II POD to 6 weeks post operatively was given as a prophylaxis against Heterotopic ossification[30].

The patients were mobilised as soon as tolerated. They were made to sit up on first POD and they were subsequently made to perform physical therapy for muscle strengthening and active range of motion exercises.

Partial weight bearing in the form of toe touch walking with walker/crutches was started at 6 weeks and was maintained up to 12 weeks. This was also individualised as dictated by other injuries of the patients. Full weight bearing was started at 3 months time. Physical therapy was continued until range of motion and muscle strength was regained.

POST – OPERATIVE FOLLOW UP:

Post-operatively all the patients were assessed with plain X-rays AP view, obturator oblique view, and iliac oblique view to assess the fracture reduction.

Serial radiographs [all the three standard views] were scheduled at two weeks, 3 months, 6 months, and one year.

Functional outcome was assessed by the Grading system of Merle D'Aubignĕ' and Postel modified score[32].

RADIOLOGICAL ASSESSMENT:

The radiographs were assessed by the criteria described by Matta[7]. The radiographs were assessed at the end of 6 months. A grade of excellent indicates a normal appearing Hip joint; good denotes mild changes with minimal sclerosis and joint narrowing (<1 mm); fair indicates a intermediate changes moderate osteophytes moderate(less than 50%) narrowing of the joint and moderate sclerosis; and poor indicates advanced changes, large osteophytes, severe (more than 50%) narrowing of the of the joint, collapse or wear of the femoral head and acetabular wear.

The reduction of the fracture was evaluated by measuring the residual post operative displacements on the three plain radiographs. The reduction

was graded as anatomical (0-1mm displacement, imperfect (2-3 mm of displacement), or poor (>3 mm of displacement)

FUNCTIONAL OUTCOME:

The functional outcome was assessed with the Merle d' Aubigně and Postel modified score which assessed the pain walking and the range of motion with each component carrying 6 points. The results were graded as Excellent (18), Very good (17), good (15 or 16) fair (13or 14), Poor (<13)[32].

Additional factors which were taken into consideration to assess the possible associations with the functional outcome were age of the patient, fracture pattern, posterior dislocation, and time interval between injury and fracture fixation.

STATISTICAL TOOLS:

The information collected regarding all the selected cases were recorded in a master chart. Data analysis was done by an independent biostatistician who was not directly involved in the study. The data were analyzed with the help of computer using Epidemiological Information Package (EPI 2008) developed by the Centre of disease control, Atlanta. Using this software range, frequencies, percentages, means, standard deviations, chi square and 'p' values were calculated. Kruskul Wallis chi-

square test was used to test the significance of difference between quantitative variables. A ’p’ value less than 0.05 denotes significant relationship.

RESULTS

In our study 18 patients with unstable displaced acetabular fractures were included and were treated with open reduction and internal fixation.

The total number male and female patients were 13 and 5 respectively. The gender did not have any relationship with the radiological or functional outcome.

The mean age in our study was 32.3 years. The age of the patient was not associated with accuracy of reduction in our study.

The post operative fracture reduction as measured on the three plain radiographs were graded as anatomical in 7(39%), imperfect in 6(34%) and poor in 5(28%) cases.

The mean initial displacement in our study was 17.9mm. The quality of fracture reduction was strongly related to the initial displacement which was statistically significant ($p = 0.0487$)

The mean interval between injury and surgery in our study was 10.8 days. The accuracy of reduction was not found to be statistically related with the timing of surgery. This may be due to the fact that all the patients in our study were operated within 3 weeks of the injury.

The fracture pattern was elemantary in 11(61.1%) patients and associated fracture types were present in 7(38.9%) patients. The reduction and the fracture pattern were not found to be statistically significant.

The associated injuries were present in 8(44.5%) patients. The fractures of the extremities were present in 4 patients who were managed with interlocking imtramedullary nailing. The intra abdominal injury (Bladder rupture) was present in one case for which bladder repair was done by urologists. The sciatic nerve injury was present in one case which is improving. The presence of associated injuries did not influence the outcome in our study.

None of our patients had iatrogenic nerve injury. 3(16.6%) of our patients had infections. Two of them had superficial infection which responded well to Intravenous antibiotics. One of our patients had deep infection and he was treated with wound debridement and flap cover was done for the raw area. The patient who had deep infection also had post operative posterior dislocation which was reduced and was maintained in lower femoral pin traction for six weeks. One patient had implant failure which occurred after malunion of the acetabulam. The functional outcome in patients with superficial infections was good. But the patient who had deep infection and posterior dislocation had a poor functional outcome. None of

the patients in our study developed Heterotopic ossification after average follow up of 8 months

The posterior dislocation of hip was present in 4(22.2%) of the patients in our study. The presence of posterior dislocation was not statistically related to the achievement of anatomical reduction.

The functional outcome which was evaluated with Merle d' Aubignĕ' and Postel modified score was found to be excellent in 4 patients, good in 6 patients, fair in 4 patients and poor in 4 patients. The radiological outcome was strongly associated with the functional outcome (p-0.0044) which strongly supports the point that achieving anatomical reduction is the most important aspect.

The mean blood loss and time taken for surgery in Kocher Langenbeck approach were 1263 ml and 2.85 hours and the mean blood loss and time taken for surgery in Ilio Femoral approach was found to be 1700 ml and3.47 hours. The relationship between the approach and blood loss was found to be statistically significant ('p'-0.0123)

RESULTS

Table 1: PROFILE OF CASES STUDIED

Variable	Value		
	Range	**Mean**	**SD**
a) Age (in years)	18-53	32.3	10.6
b) Timing of surgery (in days)	3-20	10.8	5.1
c) Initial displacement (in mm)	13-26	17.9	3.7
d) Merle D' Aubigene and Postel modified score	9-18	14.3	3.3
e) Loss of blood (in ml)	800-1700	1336	282
f) Time taken (in hours)	2.4 – 3.6	2.95	0.4

TABLE 2

Fracture type	Cases	
	No	**%**
Elementary type		
Anterior column	1	5.6
Posterior column	2	11.1
Transverse	7	38.9
Simple	1	5.6
Elementary type total	**11**	**61.1**
Associated type		
a) Both columns	1	**5.6**
b) Hemi transverse with posterior wall	3	16.7
c) Posterior column + Posterior wall	1	5.6
d) T type	1	5.6
e) Both column high type	1	5.6
Associated type total	**7**	**38.9**
Total	**18**	**100**

Table 3: Posterior dislocation

Posterior dislocation	Cases	
	No	%
Present	4	22.2
Absent	14	77.8
Total	18	100

Posterior dislocation was present in nearly one fourth of the cases.

Table 4: Associated injuries

Associated injuries	Cases	
	No	%
Sacred alar with sacral joint disruption	1	**5.6**
Extremity Fracture	4	**16.7**
Pubic diastosis SPR & IPR (R)	2	**11.1**
Bladder rupture	1	**5.6**
Total cases with associated injuries	**8**	**44.5**
Total cases without associated injuries	**10**	**55.5**
Total	**18**	**100**

44.5% of the cases studied had associated injuries.

Table 5: Merle D' Aubignĕ and Postel Modified Score

Merle D' Aubignĕ and Postel Modified Score	Cases	
	No	%
Excellent	4	22.2
Good	6	33.3
Fair	4	22.2
Poor	4	22.2
Total	18	100

55.5% of the cases had excellent and good scores and the remaining 44.5% had fair and poor scores.

Table 6: Reduction

Reduction	Cases	
	No	%
Anatomical	7	38.9
Imperfect	6	33.3
Poor	5	27.8
Total	18	100

The reduction was anatomical in 38.9 % of the cases. Imperfect and poor reductions were seen in 61.1 % of cases.

Table 7: Approach

Approach	Cases	
	No	%
KL	15	83.3
Ileofemoral	3	16.7
Total	18	100

KL approach was made in majority of the cases (83.3%).

Table 8: Age and reduction

Reduction	Age in years (Mean $\pm$ SD)
Anatomical	37.9 $\pm$11.7
Imperfect	26.7 $\pm$12.4
Poor	31.4 $\pm$8.3
'p'	0.1392 Not significant

Cases with anatomical reduction had higher age (37.9 $\pm$11.7 years) than cases with imperfect and poor reduction. But this reduction was not statistically significant ('p' > 0.05).

Table 9: Associated injuries & reduction

Associated injuries	No. of cases	Reduction					
		Anatomical		Imperfect		Poor	
		No	%	No	%	No	%
Present	8	2	25	4	50	2	25
Absent	10	5	50	2	20	3	30
'p'		0.2783 Not significant					

There was no significant relationship between presence or absence of associated injuries and the type of reduction.

Table 10: Initial displacement and reduction

Reduction	**Initial displacement (in mm)** **(Mean ± SD)**
Anatomical	15.7 ±3.68
Imperfect	18 ±2
Poor	20.8 ±3.56
'p'	**0.0487** **Significant**

Initial displacement was lower (15.7 ±3.68 mm) in cases with anatomical reduction than cases with imperfect and poor reduction. This difference was statistically significant (p = 0.0487).

Table 11: Reduction and timing of surgery

Reduction	**Timing of surgery (in days)**				
	(Mean ± SD)	**0-14 days**		**14-21 days**	
		No.	**%**	**No**	**%**
Anatomical	10.4 ±5.3	6	85.7	1	14.3
Imperfect	9.5 ±2.17	6	100	-	-
Poor	12.8 ±7.33	3	60	2	40
'p'	0.7101 Not significant				

The association between reduction and timing of surgery was not statistically significant (p = 0.7101).

Table 12: Associated injuries and outcome

Associated injuries	No. of cases	Outcome					
		Good & Excellent		Fair & Poor		Score	
		No	%	No	%	Mean	SD
Present	8	3	37.5	5	62.5	13.13	2.64
Absent	10	7	70	3	30	15.3	3.59
'p'		0.0626 Not significant					

Outcome of the procedure was not significantly associated with presence or absence of associated injuries ($p > 0.05$).

Table 13: Reduction and Score

Reduction	Score (Mean ± SD)
Anatomical	16.57 ±1.8140
Imperfect	15.33 ±1.5
Poor	10 ±2.24
'p'	**0.0044 Significant**

Relationship between Score and reduction was statistically significant. ($p = 0.0044$).

Table 14: Type of fracture & reduction

Type of fracture	No. of cases	Reduction					
		Anatomical		Imperfect		Poor	
		No	%	No	%	No	%
Simple	11	5	45.5	4	36.4	2	18.2
Associated	7	2	28.6	2	28.6	3	42.9
'p'		0.4169 Not significant					

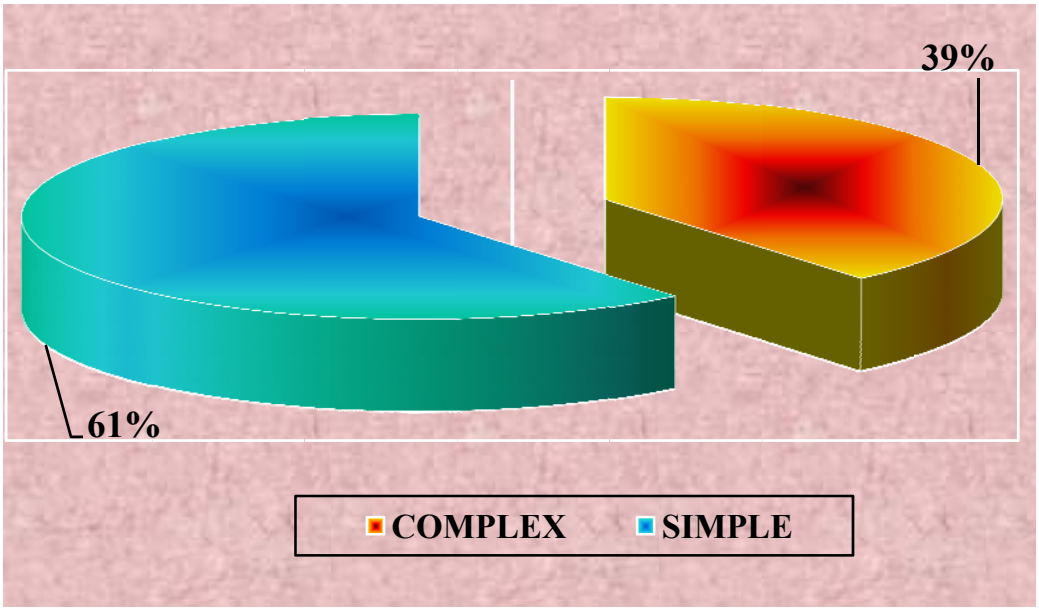
There was no significant relationship between type of fracture and the type of reduction.

Table 15: Posterior dislocation and reduction

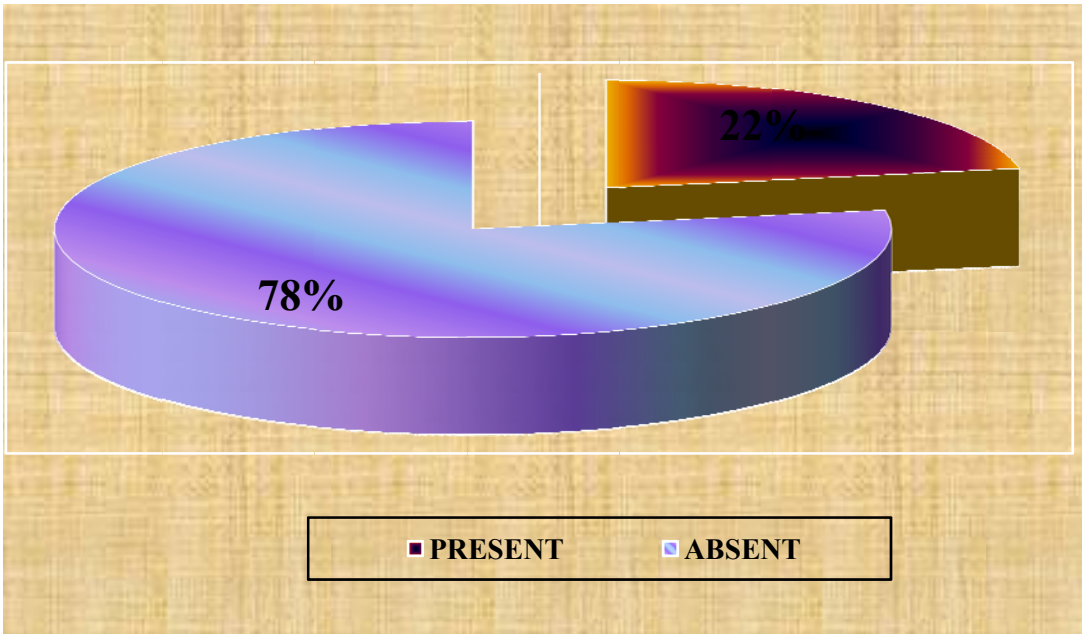
Posterior dislocation	No. of cases	Reduction					
		Anatomical		Imperfect		Poor	
		No	%	No	%	No	%
Present	4	3	75	-	-	1	25
Absent	14	6	42.9	4	28.6	4	28.6
'p'		0.2882 Not significant					

There was no significant relationship between type of fracture and the type of reduction.

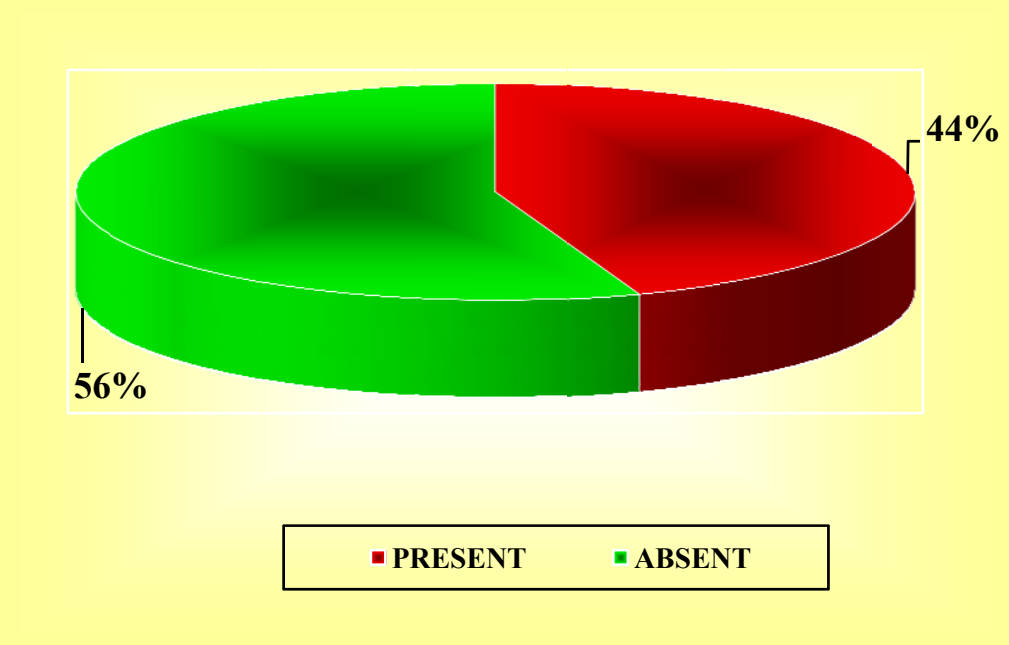
FRACTURE TYPE



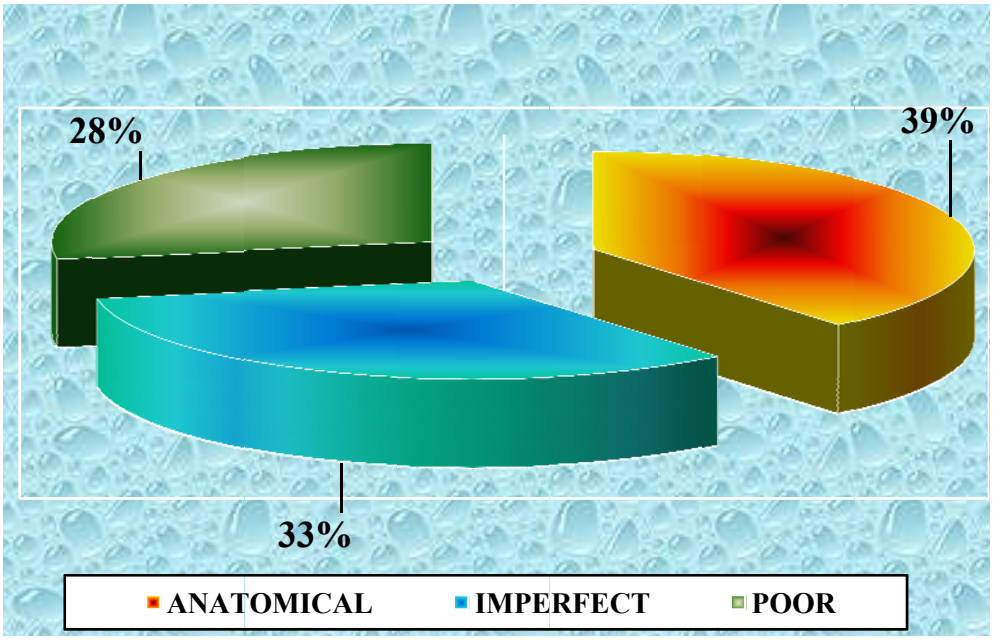
POSTERIOR DISLOCATION



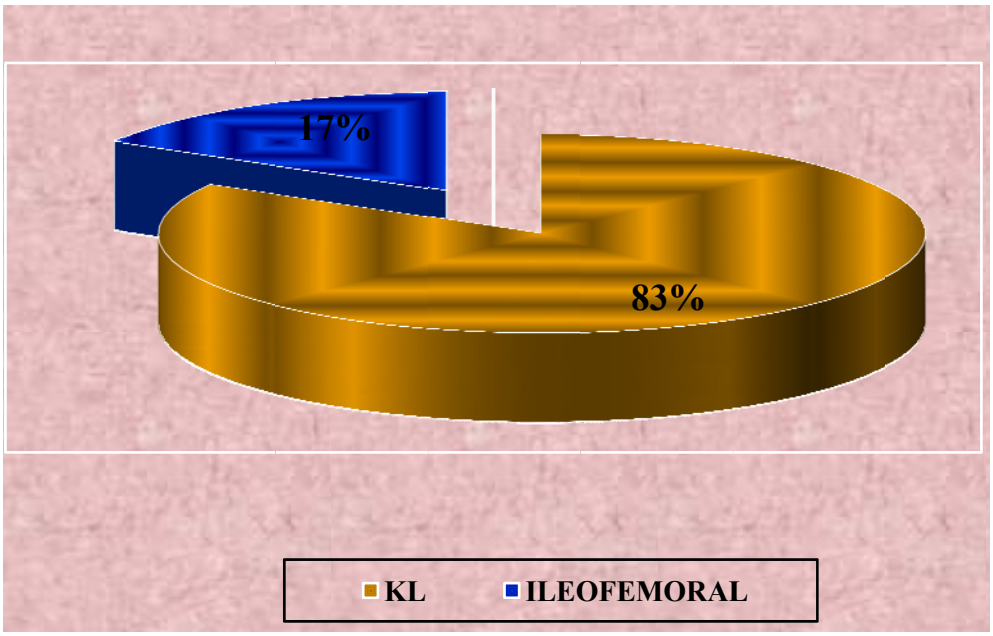
ASSOCIATED INJURIES



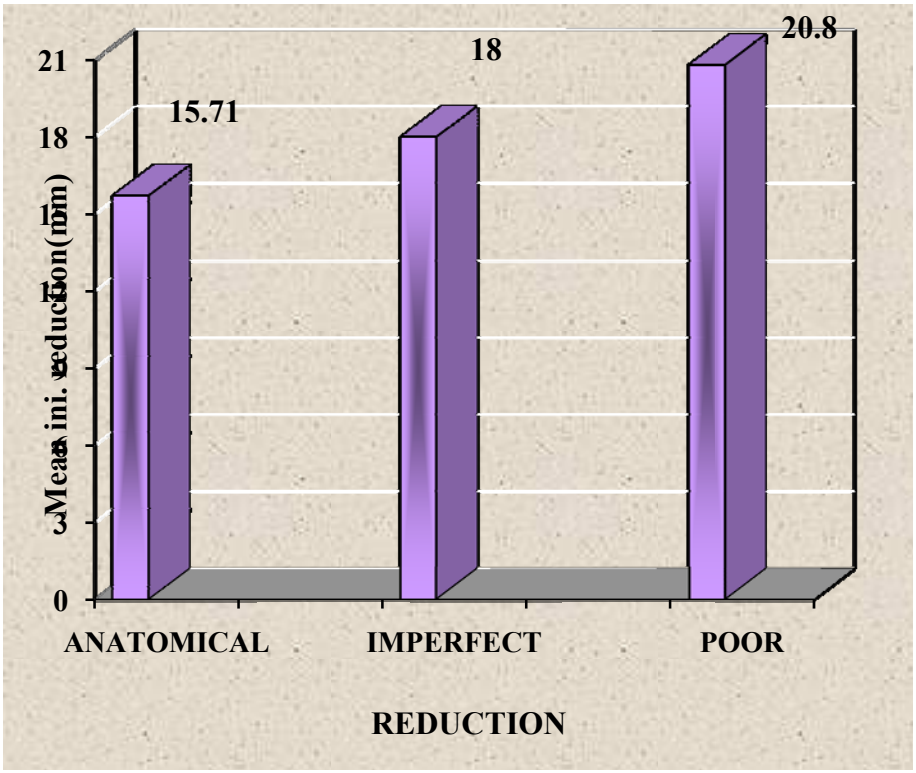
REDUCTION



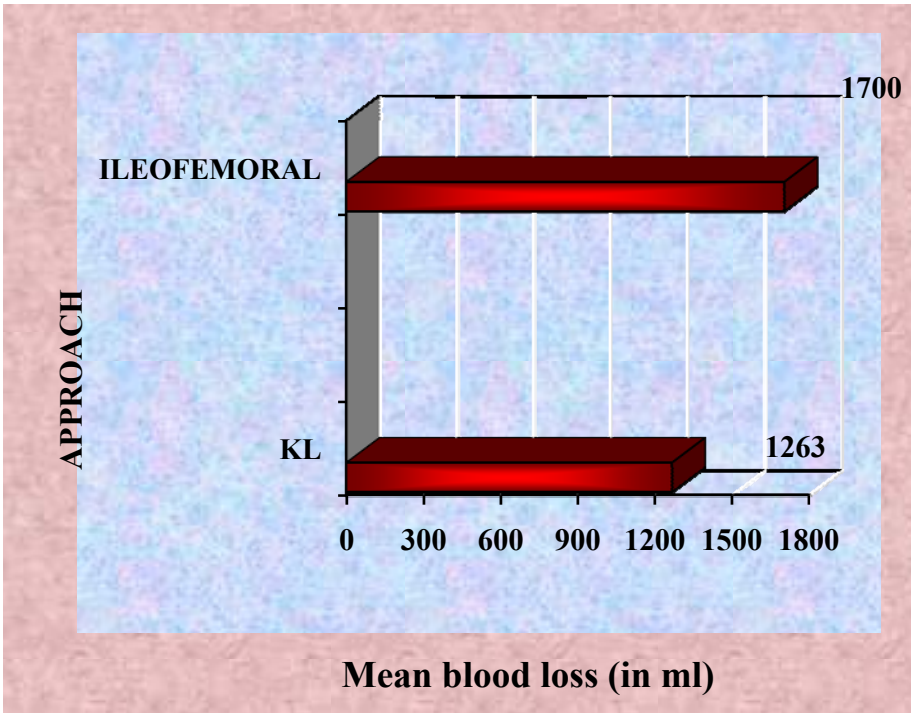
APPROACH



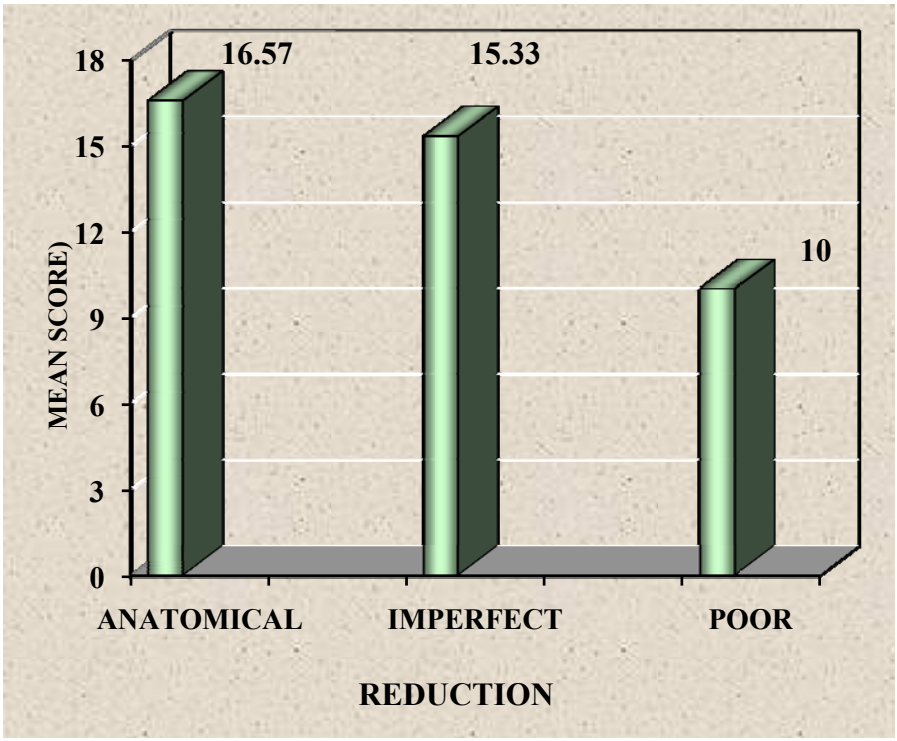
INITIAL DISPLACEMENT AND REDUCTION



APPROACH AND BLOOD LOSS

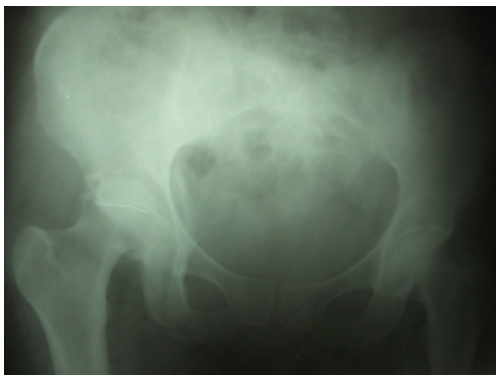


REDUCTION AND SCORE

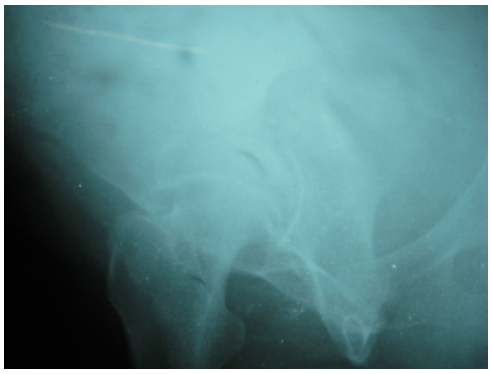


ILLUSTRATIVE CASES

CASE 1

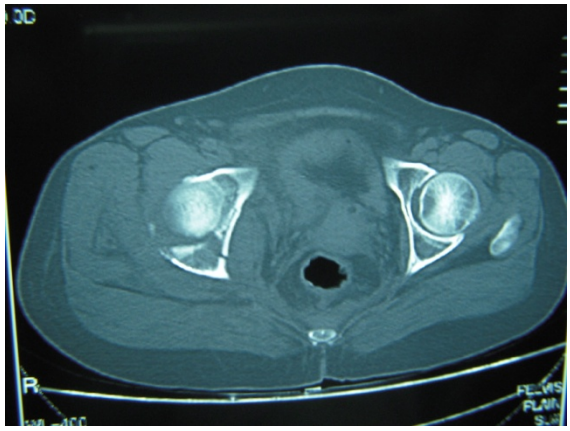


Pre Operative X-ray



Pre Operative X-ray

Pre operative 3D reconstruction



Pre Operative Axial CT

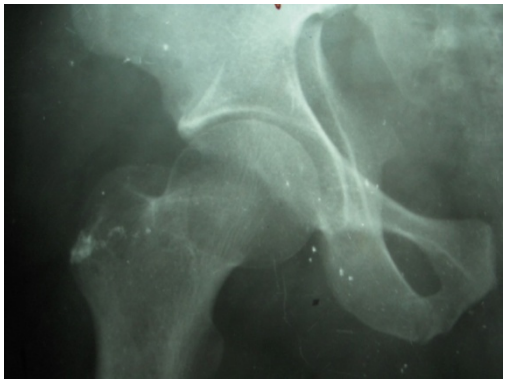
Post Operative AP view

Post Operative Obturator oblique view

Post operative Iliac Oblique view

Post Operative Clinical

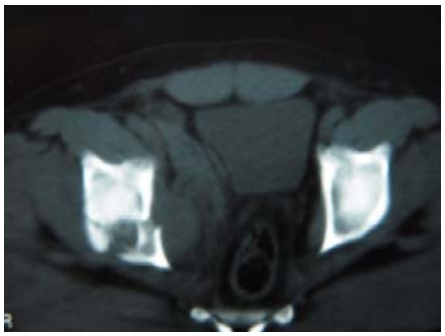
CASE 2

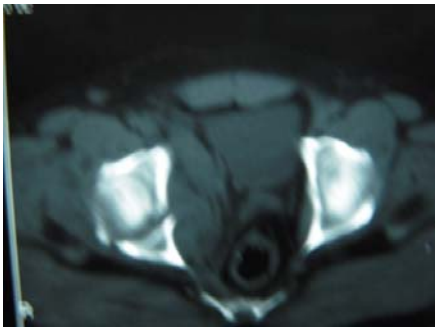


Pre operative AP view

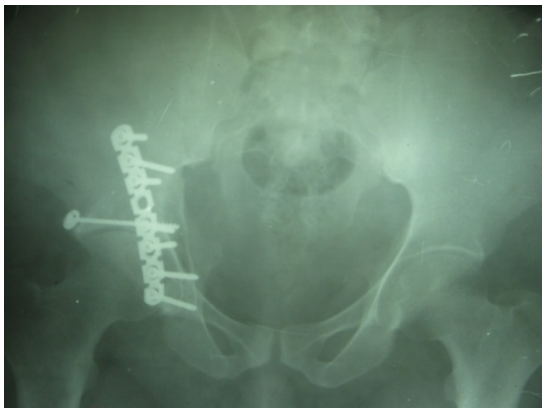
Pre operative obturator oblique view

Pre operative iliac oblique view

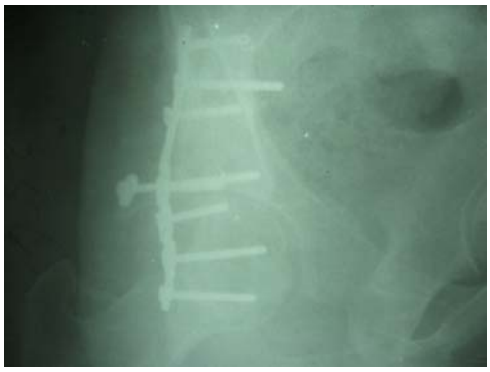


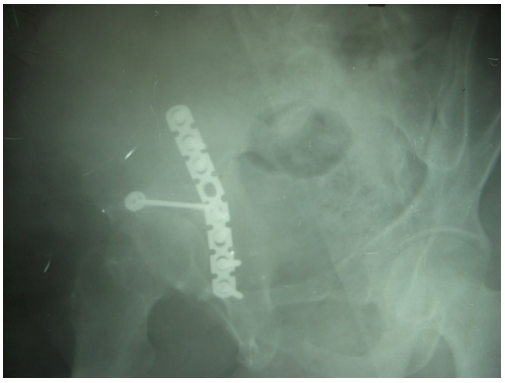


Pre Operative Axial CT scan

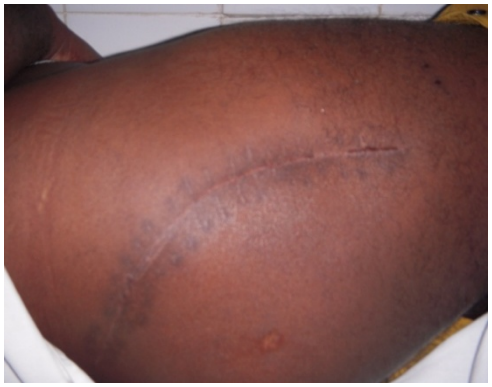


Post operative X-ray AP view





Post operative X-ray obturator oblique view and iliac oblique view



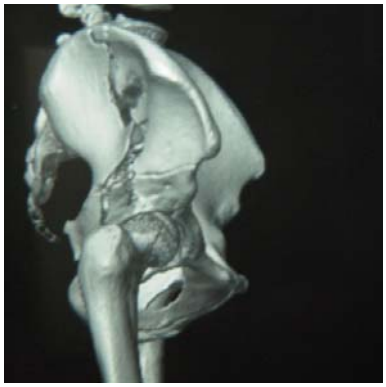
Post operative follow up

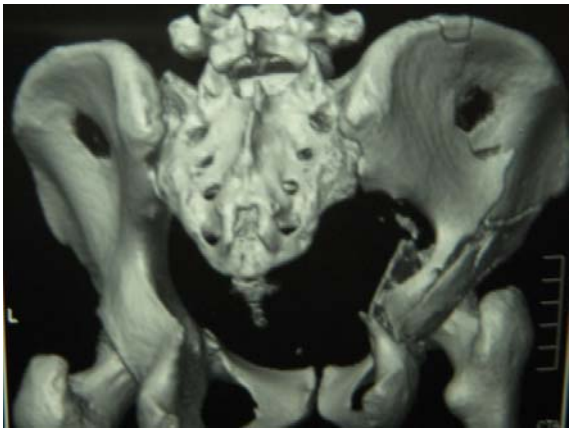
CASE 3

Pze operative AP view

Pre op Obturator oblique view

Pre op iliac oblique view





Pre Operative 3D Reconstruction

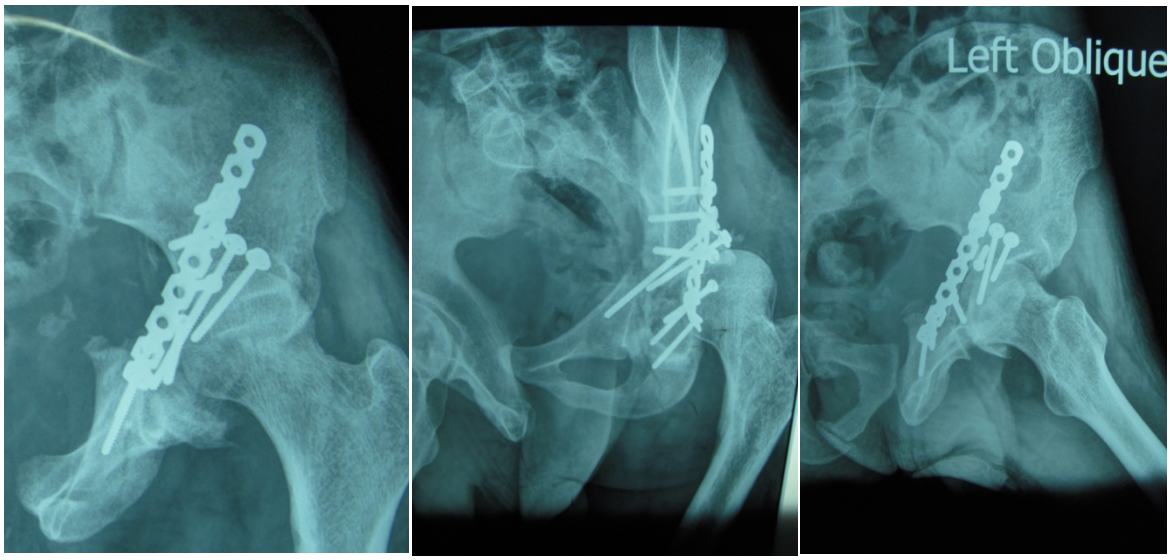
Post OP AP View

Post OP Obturator Oblique view and Iliac Oblique View

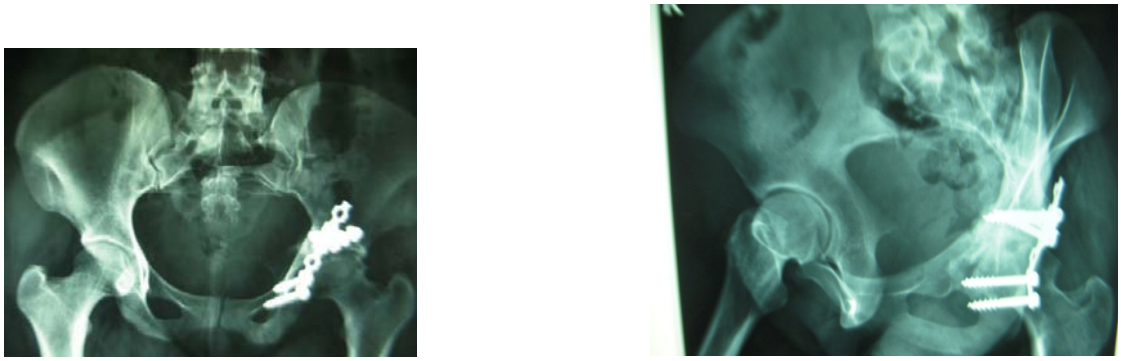
Post operative follow up

Post Operative follow up

COMPLICATIONS:



Post Operative Posterior dislocation



Post Operative Picture Showing Broken Plate

DISCUSSION

Fracture of the acetabulam still remains a Bermuda Triangle for the orthopaedic surgeons of developing country such as ours due to the lack of technical expertise and inadequate infrastructure[33]. The variables such as initial injury to the articular surface, residual intra articular step, lost vascularity to the femoral head are also the important factors that determine the outcome, including the degenerative changes in the hip joint[34].

The anatomical reduction of the fracture is the single most important factor which determines the functional outcome[7, 10,11,13]. In our study also radiographic congruity correlated well with the functional outcome. In our study 45.5% of the patients with simple fractures attained good anatomical reduction compared to 28.6% of patients with associated fracture types.

Matta et al, Letournel and Judet strongly suggested that the surgeons should be well trained and specialized in evaluating the radiological anatomy of the fracture, planning the optimal treatment strategy including the approach and attaining perfect anatomical reduction[7, 17, 20, 21].

The infection rate in our study was 16.6 % which was higher than that reported in other series 0-3% [7, 10, 11]. The cause of may be due to delayed interval between injury and surgery, more soft tissue stripping and longer

duration for surgery. The post operative posterior dislocation that occurred in one patient might have been due to highly comminuted fracture pattern. He was treated with closed reduction and was maintained in lower femoral pin traction for six weeks. The outcome was poor in that patient which was due to poor anatomical reduction.

In our study one patient had plate breakage which may be due to the indigenous make of the reconstruction plate which could not withstand the stress.

Another factor which closely correlated with the outcome was the time interval between injury and fracture fixation[7,21]. 85.7% of the patients who had earlier surgery had good anatomical reduction and functional outcome.

The age of the patient which was strongly related to the outcome in Matta's[7,] study did not have any effect on the outcome in our study. This may be due to reason that the number of patients in our study was much lower.

The other important factor, as suggested by Matta et al and other authors, which determines the radiological outcome, is the initial displacement of the fracture fragment. In our study also the amount of initial displacement correlated well with the outcome.

The use of single exposure for even both columns fracture with indirect reduction of the opposite column is currently recommended as the

morbidity associated with extensile approaches was found to very high. The opposite column fracture can be treated with the help of image intensifiers, traction and also with the help of Judet fracture tables[14,15,16].

In our study there were no Avascular necrosis of femoral head, secondary arthrosis of the hip joint or heterotopic ossification which may be due to the reason that the mean follow up was short term in our study.

CONCLUSION

The surgical treatment of unstable displaced acetabular fractures is universally accepted since the conservative management of the complex unstable displaced fractures produced consistently poor results[1, 2, 3, 4, 5]. The key to success in the surgical treatment of acetabular fractures is the understanding of the anatomy of the fracture, pre operative planning for the approach and type of reduction.

No doubt, it involves a long learning curve and the treatment should be done in a specialized tertiary care centre which has a specialized team for managing the acetabular fractures as even the most quoted authors of acetabular fractures such as Matta and Letournel had unsatisfactory results during their early days.

The surgical treatment of acetabular fractures if presented late is difficult, but possible. Even though poor results are more probable of late fixation, the total hip replacement which may be needed subsequently in such cases will be easier [35].

Though various factors such as age, initial displacement and the time interval between injury and surgery affect the outcome of the surgical

treatment , the surgical treatment of unstable acetabular fractures is the recommended treatment option in all patients otherwise contraindicated.

The goal of the surgical treatment should be to produce a functional mobile painless joint that continues to function till the rest of life for the patient which is best achieved by anatomical reduction of fractures and stable fixation, the most important factor that determines the outcome. Though not all the factors for a positive outcome are in the surgeon's hand he should strive for the best possible treatment that should be given to the patient.

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PROFORMA

Name: **Age:**

Sex:

Address:

IP No: **Unit:** **DOA:** **DOS:**

Ward:

Mode of Injury:

Side of Injury:

Associated Injuries: Head/Abdominal/Other pelvic fractures/ Extremity injuries

Letournel and Judet Classification:

Investigations:

- Plain X-ray Pelvis AP view Obturator Oblique View and Iliac View
- CT Axial and 3D Reconstruction
- Blood Hb/Sugar/ Urea/ Creatinine/ Grouping and Typing
- Chest X-ray
- ECG

Initial Management:

- Improvement of General Condition
- Reduction of Posterior dislocation if present

- Skeletal Traction till definitive surgery
- Treatment of other associated injuries

Surgery: Interval between injury and surgery

- Type of anaesthesia
- Patient positioning
- Approach
- Type of Implant
- Any Adjunctive Procedures
- Operative time and blood loss

Post Operative:

- Mobilisation
- Type of physiotherapy

Complications:

- Infection- Early/Late
- Venous Thrombo embolism
- Heterotopic Ossification
- Avascular Necrosis of femoral head
- Post traumatic Arthrosis

Follow Up:

- Radiological Assessment: X-ray Pelvis AP view, Obturator oblique view, Iliac Oblique view

  2 weeks: 6 weeks: 3 months: 6 months: 1 year:

- Functional Assessment: Merle D' Aubigne' score

MASTER CHART

Name	Age/ Sex	Fracture type	Posterior dislocation	Associated injuries	Initial displacement	Time interval between injury and surgery(days)	Approach	Blood Loss	Reduction	Merle D' Aubigne' Postel Modified Score	Time taken for surgery
1)Ajith Muthu	18 M	Simple (Transverse L)	_	+ SPR &IPR (R)	16 mm	10	Kocher Langenbach	900ml	Imperfect	16(good)	2.4 hours
2)Ambiga	19 F	COMPLEX (Bicolumnar R)	_	_	21 mm	6	Kocher Langenbach	1350 ml	Imperfect	16(good	3.2 hours
3) Arul Samy	45 M	Simple (Transverse R)	+	-	19 mm	8	Kocher Langenbach	950ml	Imperfect	14(fair)	2.8 hours
4)Ayyavu	35 M	Simple (Transverse R)	_	+ With Sacral alar # with sacral joint disruption R)	14mm	8	Kocher Langenbach	1200 ml	Anatomical	15(good	2.6 hours
5)Balamurugan	40 M	Complex (T type R)	_	+ #BB LEG R	17mm	11	Ilio Femoral	1600 ml	Imperfect	15 (good)	3.4 hours
6)Chandra	46 M	Complex (Hemi Transverse with Posterior wall L)	_	_	22 mm	20	Kocher Langenbach	1200 ml	Poor	14 (fair)	3.6 hours
7)Kamban	28 M	Complex (Both column R)	_	+ #BB LEG R	26 mm	20	Ilio Femoral	1700ml	Poor	9(poor)	3.6 hours
8)Kanagasabai	53 M	Complex (Hemi Transverse with Posterior wall L)	+	+ Pubic diastasis SPR &IPR (R)	20 mm	13	Kocher Langenbach	1350 ml	Anatomical	14 (Fair)	3.2 hours
9)Muthu	30 M	Simple R (Transverse L)	_	_	17 mm	3	Kocher Langenbach	1100ml	POOR	9(poor)	2.6 hours

10) Pandiarajan	27 M	Complex (Hemi Transverse with Posterior wall L)	_	+ Sacral# Bladder rupture	21 mm	9	Kocher Langenbach	1450 ml	POOR	9(poor)	3.3 hours
11) Pothiraj	19 M	Simple (Transverse L)	_	_	19 mm	10	Kocher Langenbach	1350ml	Imperfect	16(good)	2.8 hours
12) Samaran	32 M	Simple (Post column R)	_	_	13 mm	19	Kocher Langenbach	1200ml	Anatomical	15(good)	2.4 hours
13)Selvi	19 F	Simple (Transverse L)	+	+ BB leg L	16 mm	12	Kocher Langenbach	1450ml	Imperfect	14(fair)	2.6 hours
14)Valli	40 F	Simple (post column R)	_	_	14 mm	10	Kocher Langenbach	800ml	Anatomical	18(excellent	2.5 hours
15)Veerapandi	30 M	Complex (post column + post wall R)	_	_	13 mm	14	Kocher Langenbach	1500ml	Anatomical	18(excellent)	3.1 hours
16)Prabhu	26 M	Simple (Transverse R)	+	+ Shaft of femur fracture ipsilateral R	18 mm	12	Kocher Langenbach	1450ml	Poor	9(poor)	2.8 hours
17)Radha Krishnan	53 M	Simple (ANTERIOR COLUMN R)	_	_	22mm	4	Ilio Femoral	1800ml	anatomical	18(excellent)	3.4 hours
18)Uma Rani	22 F	Simple (Transverse L)	_	_	14 mm	5	Kocher Langenbach	1700 ml	Anatomical	18(excellent)	2.8 hours

THE MODIFIED MERLE D' AUBIGNE' AND POSTEL CLINICAL GRADING SYSTEM

Parameter	Points
1) **Pain**	
None	6
Slight or intermittent	5
After walking but resolves	4
Moderately severe but patient is able to walk	3
Severe, prevents walking	2
2) **Walking**	
Normal	6
No cane but slight limp	5
Long distance with cane or crutch	4
Limited even with support	3
Very limited	2
Unable to walk	1
3) **Range of motion**	
95% to 100%	6
80% to 94%	5
70% to 79%	4
60% to 69%	3
50% to 59%	2
<50%	1

Clinical Score:

Excellent	18
Very good	17
Good	15 or 16
Fair	13 or 14
Poor	<13